Bureau of Land Management Cultural Resources GIS

A Baseline Model

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Introduction

The Bureau of Land Management (BLM) has a large investment in developing tabular and spatial information on cultural resources. Some data are (or were) being developed internally but a large proportion is developed by State Historic Preservation Offices (SHPOs) with whom BLM has formed a development alliance. BLM is also making delivery of digital data a contract specification for cultural resource firms working on BLM lands.

There is some confusion about how data should be gathered, received, and distributed for and by BLM and its SHPO partners. The purpose of this short paper is to propose a minimum model for spatial and tabular data. The model draws from work conducted or coordinated by the New Mexico and Wyoming SHPOs and Gnomon, Inc. sponsored by the Federal Geographic Data Committee, the National Park Service, and the BLM on western U.S. cultural resources GIS standards (see http:// colby.uwyo.edu/ fgdcncptthome.html). The discussion also relies upon a consideration of how the different SHPOs are creating spatial data and how field offices use spatial data.

The Nature of the Data

From the BLM perspective, cultural resources consist mostly of archaeological sites. Most western states have around 50,000 known archaeological sites each. New Mexico and Arizona have about twice this number, and California has at least 250,000 archaeological sites. No states are fully inventoried, so there are undoubtedly at least two to three times this number of sites in each state. Within the western U.S., from Montana to New Mexico and westward, then, there are roughly 1.5 million archaeological sites. Because BLM has extensive landholdings in most western states, many of these sites will be or are on BLM managed lands.

The National Historic Preservation Act of 1966 requires that SHPOs maintain an inventory of known cultural resources within their states. The inventory has been built over time, and reflects changes in the practice of cultural resources. Nevertheless, a 50 year old site record is as valid as a one week old record.

Older records are often narratives. Maps are drawn from a wide variety of sources, partly dependent upon what the investigator had on hand. So, source maps range from USGS 1:250,000 to USGS 1:24,000 scale. Many sites were plotted on 1:62,500 series maps.

In the 1970's and 1980's most states began to use standardized site records with an eye toward automation into databases. These records are still in use. Standardized locator maps on best available USGS maps are called for in most of these records, so one sees the use of 1:24,000 published maps, 1:24,000 pre-prints, and 1:62,500 map plots as

part of these records. UTM coordinates (centerpoint and/or bounding quadrilaterial) were requested on many site record forms. Cadastral attributes (township, range, section, and alloquot parts down to 10 acres for some states) are also part of most site records beginning around 1980.

Tracking where adequate systematic inventory of cultural resources has been done ("inventoried space") is just as important as tracking the resources. Relatively few states have systematic data collection forms for this aspect of the record. BLM and the Forest Service have set standards for reporting and most western states follow these general guidelines. Systematic information gathering requires ferreting through the reports themselves (which are also retained in the SHPO archives). Some states have systematically retained survey coverage maps, showing investigation locations throughout their state. Other states do not currently keep such maps.

Many BLM field offices have also retained their own archival records. These may be better or worse than the statewide inventories; certainly they are more spatially restricted. On the other hand, the agency files contain resource and inventory records that never went to a SHPO and may never have gone to a SHPO inventory.

Spatial Models of Cultural Resource Data

Before considering spatial models of cultural resources, one must consider the spatial scale at which a model is useful. While the following discussion is phrased as pertaining to cultural resources, because it considers the spatial representation of phenomena, it also applies to cultural resource inventories. Spatial scale accords to acceptable error or inaccuracy, generally. So, the discussion below is phrased in terms of three aspects of spatial data. These are:

- The scale of data collection in the field
- The scale at which data are translated from the field to an automated system
- The scale at which data are used in an automated system

Field data collection is generally at scales of 1:24,000 or larger. In general, the worst case for field locating data is that the archaeologist uses topography, compass triangulation, and map features to locate a resource or study area boundary. GPS use is increasing (and perhaps should be required on BLM projects), so we can expect more accurate spatial locations coming from fieldwork in the future.

Skipping over the translation scale issue for the moment, a presentation and analysis scale of 1:24,000 is appropriate for data usage. Note that this does not mean spatial data should be *collected* in the field or input through digitization processes at this scale; rather, we intend to use collected data with the degree of *inaccuracy* present in the national map accuracy standards for 1:24,000 published maps.

Cultural resources vary in size, shape, and in how distinct their boundaries are. Because of this, the most "natural" representation of a cultural resource depends upon the resource itself. At 1:24,000 scale, logic dictates that areas below about 2.5 acres will appear as dots. 2.5 acres is about 100,000 square feet, or a circle of about 360 foot diameter. On paper, this is a circle of about 0.2 inch diameter – a discernable large dot.

Other cultural resources are inherently linear in nature. Railroads, trails, canals, ditches, and communication lines are obvious linear resources. If the segment being

mapped is long enough, the "natural" representation may be a line. It is worth noting that linear cultural resources may best be represented as a point if one sees only a small part of the original linear phenomenon. For example, if the sole visible trace of a telegraph line is a single pole, a dot is just as correct as a line.

Lastly, cultural resources also can be spatially extensive, so that neither lines nor points are sufficient representations. This is often the case for inventoried spaces. In the FGDC sponsored metadata discussion cited above, we proposed a tiered system of representation, ranging from points and lines, to buffered points and lines, to actual polygons.

Cultural resource spatial data requires some incorporation of all of the recommended levels of representation *on the data input side*. That is, to represent cultural resources correctly in our spatial information systems, one must be able to enter information as points, as lines, and as polygons.

In sum, the available spatial software models fit pretty well with the nature of cultural resources information. One ends up with the scheme shown in Table 1.

Spatial Representation	Resource information	Inventory information
POINT	No more than 2.5 acres in extent	No more than 2.5 acres in extent
LINE	At least 30m (100') in length	At least 60m in extent
POLYGON	>2.5 acres in extent	> 2.5 acres in extent

Data Creation vs. Data Use

So far, we have stated the obvious: to use data reliably at a scale of 1:24,000 one must collect it at a scale of 1:24,000 or (far preferably) larger scales, translate data appropriately and make spatial data available at a scale of 1:24,000. The good news is that this is not especially difficult. One digitizes points lines and polygons as appropriate, creating six basic themes, or coverages, or whatever one chooses to call them:

- Cultural resource points
- Cultural resource lines
- Cultural resource polygons
- Cultural resource inventory/investigation points
- Cultural resource inventory/investigation lines
- Cultural resource inventory/investigation polygons

The bad news is that *the spatial model for data input is too complex for many data users*. Data users in BLM are field office cultural resource specialists, managers, and other BLM staff. Most of the time, query consists of asking "what is in and near my proposed project area?". Phrased spatially, this is a selection by overlay. The selection results can return 6 different tables. The three tables for resources need to be joined and duplicates eliminated, and the the three tables for inventories joined and cleaned for duplicates. This task can be automated, but it is needlessly complex.

A simpler mode of operation is to have data that is *only in polygonal format for general user query*. This creates two datasets (one for resources, one for investigations). Attributes can be pre-joined to the data to make it easy to use. The other formats can still

be available to the GIS user (they are very useful for cartographic purposes), but would not be part of the routinely queried dataset.

There are many advantages to separating data creation formats from data use formats. Some of these are:

- Applications need only be developed for a single GIS entity class. These may include business model rules like those for Nobility and scripting in different software packages
- Symbology on maps can focus more on data values rather than GIS feature classes
- Different data creation modes will all appear the same to the user, throughout BLM
- We can insist on a simple consistent set of joined attributes in order to create a simple comprehensive dataset.

In summary, what is proposed is to recognize two distinct sets of data:

- Source GIS
- Synthetic GIS (polygons)

The synthetic GIS is created through buffering of points (to 2.5 acres or smaller, as local standards dictate), buffering of lines (by width for linear resources and inventories), followed by union with existing polygons.

Attributes and Metadata

FGDC compliant metadata is required for all datasets. FGDC compliant documents apply to entire datasets. As the discussion above makes clear, this is not difficult at a statewide level, since one has only six basic datasets to document, plus two or so derived datasets.

Cultural resource data is not collected in a uniform manner. Some resources are mapped at small scale, some at large scale, and so on. This differs from a "standard" GIS dataset like roadways, which typically has a single consistent source of observation. (I suspect that variable spatial sources are more often the rule than the exception in BLM datasets.) The result is that to make the user aware of limitations in the spatial data one must keep metadata at the individual feature level. At a minimum this consists of:

- Spatial data source (scale and inaccuracy, e.g. 1:24,000 map plot, GPS data of nominal 10m accuracy (SA-OFF raw data), etc.). We need to recognize that spatial data can be of mixed heritage too (e.g., a GPS derived boundary that is incomplete and is augmented by map digitization)
- GIS data creation date
- GIS data verification to original status
- Locational confidence (this may differ from spatial data source – for example, one could have a convincing map plot at 1:24,000 scale to work from but find great inconsistencies in the site record which suggest the site is mis-plotted)
- Boundary completeness (i.e., is this a partial digitization of a larger phenomenon)
- Nominal width for linear features, nominal maximum area for point features (e.g., 2.5 acres is proposed above)

Other attributes are discussed in detail in the FGDC report, but those above seem to be the minimal acceptable set.

The attributes above apply to data creation. The synthetic polygons need to have some additional metadata:

- Date synthetic polygon was created
- Synthetic polygon source (line, point, polygon)
- Boundary heritage (buffer, mixed heritage, GPS, map-derived, etc.; this differs from spatial data source)

Attributes are discussed fully in the FGDC report cited above. For both the synthetic and source GIS data, there is a simple set of cultural resource attributes one is almost always going to want to have joined to the spatial data:

- Date of field observation
- Resource or inventory identification string(s)
- Resource or inventory database key id
- Resource National Register status
- Resource National Register status determination date
- General resource age (prehistoric, historic, both)
- Inventory field method type (Class III, cursory, etc.)

Applications and Into the Future

The discussion above is compatible with the current BLM standards for cultural resource GIS data. It also provides a blueprint for BLM and SHPO collaboration on spatial data creation and use, so that BLM and SHPOs can invest in a single set of shared data query tools and perhaps even shared data creation tools. Of great importance is the notion that one could supply a third-party cultural resource specialist with a data format to populate.

One common question has been how to accept GPS data. GPS data are not inherently useful without some conversion into GIS. The formats tend to be too idiosyncratic and there may be a need to edit the spatial data before it is correct. Using a GIS format as the common standard will allow BLM and SHPOs to accept GPS-derived information in a controlled, appropriate, fashion.